

## **E057: Renal Stone Risk Assessment During Space Flight: Assessment and Countermeasure Validation**

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Exposure to the microgravity environment results in many metabolic and physiological changes to humans. Body fluid volumes, electrolyte levels, and bone and muscle undergo changes as the human body adapts to the weightless environment. Changes in the urinary biochemistry occur as early as flight day 3-4 in the short duration Shuttle crewmembers. Significant decreases were observed both in fluid intake and urinary output. Other significant changes were observed in the urinary pH, calcium, potassium and uric acid levels. During Shuttle missions, the risk of calcium oxalate stone formation increased early in the flight, continued at elevated levels throughout the flight and remained in the increased risk range on landing day. The calcium phosphate risk was significantly increased early in-flight and remained significantly elevated throughout the remainder of the mission.

Results from the long duration Shuttle-Mir missions followed a similar trend. Most long duration crewmembers demonstrated increased urinary calcium levels despite lower dietary calcium intake. Fluid intake and urine volumes were significantly lower during the flight than during the preflight. The calcium oxalate risk was increased relative to the preflight levels during the early in-flight period and continued in the elevated risk range for the remainder of the space flight and through two weeks postflight. Calcium phosphate risk for these long duration crewmembers increased during flight and remained in the increased risk range throughout the flight and following landing.

The complexity, expense and visibility of the human space program require that every effort be made to protect the health of the crewmembers and ensure the success of the mission. Results from our early investigations clearly indicate that exposure to the microgravity environment of space significantly increases the risk of renal stone formation. The early studies have indicated specific avenues for development of countermeasures for the increased renal stone risk observed during and following space flight. Increased hydration and implementation of pharmacological countermeasures are being tested for their efficacy in mitigating the in-flight risk of renal stones. Maintaining the health and well-being of crewmembers during space flight requires a means of minimizing potential detrimental health effects of microgravity. The formation of a renal stone during flight obviously has severe consequences for the affected crewmember as well as the success of the mission.

In our current study, planned for the International Space Station, we will continue to assess the renal stone-forming potential of humans during long-duration space flight and determine how long after space flight the increased risk exists. Urine will be collected before, during and after flight. Food, fluid, exercise and medications will be monitored before and during the urine collection in order to assess any environmental influences other than microgravity. Potassium citrate will be ingested by participating crewmembers in order to evaluate the effectiveness of potassium citrate as a countermeasures to the altered urinary chemical environment observed during and after during space flight.